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Decentralized Systems Technology Fact Sheet
Low Pressure Pipe Systems

DESCRIPTION

Although not an alternative to all unsuitable soils, the low-pressure pipe (LPP) system has proven to be useful for some specific conditions, where conventional systems frequently fail. Less than one-third of the land area in the U.S. has soil conditions suitable for conventional soil absorption systems. Numerous innovative alternatives to the conventional septic tank soil absorption system have evolved in response to the demand for an environmentally acceptable and economical means of disposing domestic wastewater onsite and contending with the restrictive soil conditions common in many states.

Originating in North Carolina and Wisconsin, a LPP system is a shallow, pressure-dosed soil absorption system with a network of small diameter perforated pipes placed 25.4 to 45.7 cm (10 to 18 inches) deep in narrow trenches, 30.5 to 45.7 cm (12 to 18 inches) wide.

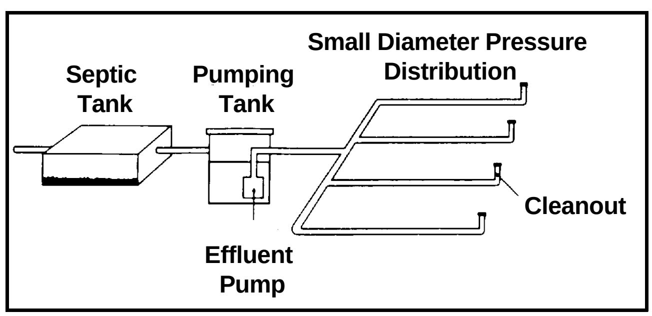
LPP systems were developed as an alternative to conventional soil absorption systems to eliminate problems such as: clogging of the soil from localized overloading, mechanical sealing of the soil trench during construction, anaerobic conditions due to continuous saturation, and a high water table. The LPP system has the following design features to overcome these problems:

- Shallow placement.
- Narrow trenches.
- Continuous trenching.
- Pressure-dosed with uniform distribution of the effluent.
- Design based on areal loading.
- Resting and reaeration between doses.

Process

The main components of a LPP system are (see Figure 1):

- A septic tank or an aerobic unit.
- A pumping (dosing) chamber (a submersible effluent pump, level controls, a high water alarm, and a supply manifold).
- Small diameter distribution laterals with small perforations (holes).



Source: USEPA, 1992.

FIGURE 1 LOW-PRESSURE PIPE SYSTEM

The septic tank is where settleable and floatable solids are removed and primary treatment occurs. Partially clarified effluent then flows by gravity from

tank to a pumping chamber, where it is stored until
which activates the pump. The level controls are set
a specific pumping sequence of 1 to 2 times daily,
lateral pipe volume, which allows breaks between
for the soil to absorb the effluent. The pump turns
the lower float control. However, the dosing
anism and frequency may vary for different systems.
provide excess storage of at least one day's capacity

failure or pump malfunction. If the pump or level
should fail, the effluent would rise to the
level of the alarm control, turning the alarm on.

pump moves the effluent through the supply line
trenches under a low pressure 0.91 to 1.5 meters
3 to 5 feet of pressure head). These laterals are
perforated holes, usually 0.4 to 0.64 centimeters
in diameter and spaced at 0.76 to
dimensions are determined for each system).

The
trenches 254. To 46 centimeters (10 to 18 inches)
(5 feet) apart.
The
so that the depth of the effluent does not exceed 5.1
7.6 centimeters (2 or 3 inches) of the total trench
depth during each dosing cycle.

Chatham County, North Carolina

A study was
Carolina, to evaluate the effectiveness of a sand
system in slowly permeable soils of a
Triassic Basin.
evaluate the operation and functioning of system
assess treatment effectiveness of a buried
hydraulic capacity and wastewater treatment

The system included a 3785-liter (1,000-gallon)
eptic tank, a Tyson flow splitter, two 3785-liter (1,000-gallon)
buried sand filter, and two similar side-by-side LPP
fields. One drain field was dosed with septic tank
sand filter effluent. This system was designed for a
house and began operating in August 1988.

of the effluent from the septic tank flowed into
Effluent from the sand filter drained into a dosing
and was then pumped to the first drain field. The
Pump Tank 2, which dosed the other LPP field.
LPP system consisted of lateral pipes (PVC) 3.2
and 0.36 centimeter (5/32 and 9/64 inch) holes and
in trenches 25.4 centimeters (10 inches) wide.
.005 meters cubed per day per meters squared (0.13
per day per square foot), and each drain field contained
centers.

It
and mechanical components performed quite well.
was excellent removal of fecal coliform orga
both drain fields, and little to no NO_3-N and NH -N were
LPP drain field receiving sand filter effluent. The
xcellent nitrogen removal resulted from the nitrification
denitrification that occurred due to shallow

The system performed well except for some partial
of the pressure distribution systems, breakage
perched water into the tanks. Extensive flushing of
and fecal coliform occurred with large rainfall events
associated with a hurricane). These observations
that the tanks should be watertight and require
conventional systems.

ADVANTAGES AND DISADVANTAGES

Some advantages and disadvantages of LPPs are listed below:

Advantages

- Shallow placement of trenches in LPP installations promotes evapotranspiration and enhances growth of aerobic bacteria.
- Absorption fields can be located on sloping ground or uneven terrain that are otherwise unsuitable for gravity flow systems.
- Improved distribution through pressurized laterals disperses the effluent uniformly throughout the entire drain field area.
- Periodic dosing and resting cycles enhance and encourage aerobic conditions in the soil.
- Shallow, narrow trenches reduce site disturbances and thereby minimize soil compaction and loss of permeability.
- LPPs allow placement of the drain field area upslope of the home site.
- LPPs have reduced gravel requirements.
- There is a significant reduction in land area required for the absorption system.
- Costs are comparable to other alternative typical distribution systems.
- LPPs overcome the problem of peak flows associated with gravity-fed conventional septic systems.

Disadvantages

- In some cases, the suitability could be limited by the soil, slope, and space characteristics of the location.
- A potential exists for clogging of holes or laterals by solids or roots.
- LPPs have limited storage capacity around their laterals.
- There is the possibility of wastewater accumulation in the trenches or prolonged saturation of soil around orifices.
- LPPs could experience moderate to severe infiltration problems.
- Regular monitoring and maintenance of the system is required; lack of maintenance is a sure precursor to failure.

DESIGN CRITERIA

Soil requirements

According to state/local regulations, a LPP system should be located in soils that have suitable or provisionally suitable texture, depth, consistence, structure, and permeability. A minimum of 0.3 meters (12 inches) of usable soil is required between the bottom of the absorption field trenches and any underlying restrictive horizons, such as consolidated bedrock or hardpan, or to the seasonally high water table. Also, a minimum of 0.5 to 0.76 meters (20 to 30 inches) of soil depth is needed for the entire trench.

Space requirements

The distribution network of most residential LPP systems utilizes about 93 to 465 meters squared (1,000 to 5,000 square feet) of area, depending on the soil permeability and design waste load. An area of equal size must also be available for future repair or replacement of the LPP system. If the space between the lateral lines will be used as a repair area, then the initial spacing between the lateral lines must be 10 feet (3 meters) or wider to allow sufficient room for repairs. Although size requirements for a LPP system vary depending on the site, in general, an undeveloped lot smaller than one acre may not be suitable for a LPP system.

The septic tank, pumping chamber, and distribution should not be located in areas where hydraulic overloading could occur from surface runoff.

critical drainage requirements are surface water
waters upslope of the system. These conditions are important on sites with concave or lower slope positions
the surface. If this condition exists, surface water perched groundwater must be diverted away from the LPP system.

There are special design considerations for LPP fields located on slopes. The distribution
pumping chamber so that gravity does not cause the to flow out of the pumping chamber and into
operating. If the topography does not allow for then the LPP system must be designed to ensure
chamber when the pump is turned off (e.g., use of anti-siphon hole or other control in the discharge piping in the pumping chamber).

Two critical factors that affect the performance of a

effluent. The first factor, the dosing and resting helps maintain aerobic conditions in the soil and
cycles back and forth between aerobic and anaerobic which can lead to favorable conditions for nitrification and denitrification. During the bic resting period, nitrification occurs. When the
conditions result in denitrification.

The
cannot be overemphasized in the performance of LPP system. The effluent must be distributed evenly
hydraulically overloading it.

The
soil, slope, available space, and anticipated

OPERATION AND MAINTENANCE

A
requires very little ongoing maintenance. However, inspection and maintenance by professional operators
documented a 40 to 50 percent failure rate when was left to the homeowners rather than professionals.
minimum monitoring frequency of every 6 months

The septic tank and pumping chamber should be for sludge and scum buildup and pumped as
solids from escaping from the septic tank. some solids may accumulate at the end of the
year. Turnups installed at the distal ends of laterals

The manufacturer's recommendations should be

ensure longer life and proper function of the pumps other mechanical/electrical components of the system.
cleaning and inspection. Pump replacements should selected based on the specific system design rather
be checked for signs of oil leakage, worn or broken or for damaged parts that need to be rep
level switches to ensure proper operation. An run-time meter and pump impulse counter should
facilitate system troubleshooting and monitoring of

In the event of a power failure or pump malfunction, visible and audible alarm is activated when the effluent rises to the level of the alarm control.
alarm should be located at the control panel to testing by the professional operator. Listed
maintenance (O&M) tasks for large LPP systems.

Although the LPP system overcomes many of the problems associated with the conventional septic tank system, there has been documentation of some operational problems with small, poorly maintained, onsite LPP systems in North Carolina. Large LPP systems in North Carolina were shown to have similar problems as well, but on a larger scale because of the size of the systems. Careful site-specific designs and regular maintenance by trained, professional operators are essential for overcoming these problems. Large LPP systems can have problems such as:

- Excess infiltration: Drain fields are very susceptible to hydraulic overloading due to infiltration. In areas with improper drainage, leaky pump tanks can become sinks for nearby groundwater. Large systems that include extensive collection sewers have a higher probability of inflow/infiltration. Watertight septic tanks and pumping chambers are essential for system performance.

- Faulty hydraulic design: For optimum performance of the system, the pumps, supply lines, manifold, laterals, and orifices must be properly designed, sized, and located. Improper hydraulic design can result in problems such as localized overloading, excessive head loss, and nonuniform distribution. The dosing volume must be large enough (5 to 10 times the lateral pipe volume) to adequately pressurize the pipe network. The manifold should feed the highest lateral first in order to improve effluent distribution to the drain field.

- Drainage: Surface runoff must be diverted away from the LPP system. If the water table becomes high in level sites, groundwater beneath community-scale LPP systems can mound up into soil absorption field trenches and cause failure. The trenches on sloping fields can experience hydraulic overloading due to subsurface flow from higher areas.

- Improper installation: Since the performance of a LPP system is sensitive to any variations in hydraulic design, proper installation is essential. Some common installation problems are; incorrect orifice size and spacing, installation of undersized substitute pumps, incorrect adjustment of level control floats and pressure head, installation of laterals at incorrect elevations, and failure to install an undisturbed earth dam in each trench where the manifold feeds each lateral. Earth dams are used at the beginning of each lateral trench to prevent redistribution of effluent from higher trenches to those lower on the landscape. Dams are not used elsewhere in the trenches.

- Orifice and lateral clogging: Poor septic tank maintenance can result in solids reaching the soil absorption field and clogging the orifices. In some older LPP systems, it was observed that slime had built up in long supply lines, manifolds, and laterals. Current practice includes sleeving the small diameter laterals within a 10.2 centimeter (4-inch) diameter corrugated drainage tubing or drain field pipe and laying the small diameter distribution laterals such that the perforations point upward.

TABLE 1 GENERAL MAINTENANCE SCHEDULE

Component	O&M Requirement
Collection system	Check for I/I and blockages.
Septic tank	Check for solids accumulation, blockages, or damage to baffles, and excess I/I.
Pump septage as required.	
Pumping chamber	Check pumps, controls, and high water alarm. Check for solids accumulation and pump as required; check for I/I.
Supply lines	Check for pipe exposure and leakage in force mains.
Soil absorption field	Provide maintenance of field and field's vegetative cover; repair broken lateral turnups.
Check for erosion and surfacing of effluent.	

Source: Marinshaw, printed with permission, 1988.

COSTS

The
contractor, the manufacturers, the site, and the
of the wastewater. The overall cost
of
capital and O&M expenses. The annual operating
ts for LPPs include power consumption for the
pumps,
repair, replacement of the components, and

In a 1989 study of LPP use among different

$2,600 to install a LPP system for a three-bedroom
The average installation cost across counties
ranged
related to the extent of LPP use within a county.
are installed
within a community, the less the cost per system.

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